Clinical Update

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Contemporary Post Guidelines

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Introduction

A post and core is necessary in endodontically treated teeth when there is insufficient tooth structure to support a final restoration. Teeth restored with posts have less tooth structure and reduced fracture resistance. Posts should only be used to retain the core. The purpose of this clinical update is to review modern guidelines for use of and preparation for posts.

Canal preparation

The ideal time to create a post space is at the root canal obturation appointment. Creating a post space upon obturation reduces the risk of contaminating the canal with saliva during a restorative appointment that is often completed without rubber dam isolation (1). Different techniques are used to remove gutta percha including heated endodontic pluggers, reamers, drills, specially designed burs and solvents used with hand or rotary files. Although statistically there is no leakage difference expected after gutta percha removal with heated endodontic pluggers or rotary reamers and burs (2,3), less procedural errors occur when a heated plugger is used. When using rotary drills to reshape or enlarge root canals, take time to assure the drill is aligned with the long axis of the root to reduce the risk of perforation or excessive thinning of dentinal walls (4).

Post length

Several studies prove that coronal leakage increases when only 2-3mm of gutta percha remains. Radiographic evaluation of 424 teeth restored with posts found teeth with < 3mm of remaining gutta percha had significantly more post-treatment apical radiolucencies (5), suggesting microbial recontamination. Retaining a minimum of 4-5mm of gutta percha is ideal and recommended to maintain an apical seal (6).

Proper post space preparation requires adequate length be gained without damaging the tooth. Generally, short posts are not retentive and increase the risk of root fracture. There is a statistically significant difference in the retentiveness of a 10mm post compared to a 5mm post, the longer post being more retentive (7). Asmussen et al. demonstrated a more favorable stress distribution when longer posts were used (8). A post approximately half the length of the root canal is adequate for retention, preserves tooth structure and maintains the apical obturation (9). Teeth with associated alveolar bone loss have a lower resistance to fracture (10). In periodontally involved teeth, the post should extend into the root canal half the distance from the crestal bone to the root apex (11).

Post diameter

To preserve tooth structure, use a post with the smallest diameter possible. Increasing the diameter of the post does not increase the retentiveness of the post and core or the restoration. In fact, it increases the risk of root fracture (12). In an in vitro model, Mireku et al. found that as the thickness of the root dentin decreased, the incidence of vertical root fracture increased (13). Using a finite element analysis, Sathorn et al. demonstrated that the fracture susceptibility increased as more dentin was removed (14). It is frequently recommended that post diameter not exceed one third the root diameter, but in a recent study by Mou et al., the optimal diameter for a cast post was approximately only one quarter of the root diameter (15).

Anatomic considerations

To avoid perforations and thinning of dentinal walls that can lead to root fracture, a working knowledge of root anatomy is essential. At least two radiographs, taken from different horizontal angulations, provide a better three-dimensional appreciation of the root anatomy than one radiograph. Prior to post selection, radiographs must be reviewed for a careful analysis of root size and anatomy (4). Since most curvatures occur in the apical 5mm of the canal, post preparation and placement should avoid this area (16). Molars do not require a post when 3-4mm of chamber height remains (17). If a molar post is needed, it should be placed in the larger palatal or distal root. To reduce procedural errors, it should not exceed 7mm in length, measured from the orifice (18). Maxillary premolars have furcation grooves on the lingual side of the buccal root. To avoid premolar furcation perforations, place posts in the lingual canal (19).

Ferrule

A ferrule is important in preventing tooth fracture and inadequate ferrule increases the risk of root fracture (14). An endodontically treated tooth with a uniform ferrule of 2mm is more fracture resistant than one without a ferrule or with a nonuniform ferrule (20). After evaluating the effect of various post lengths on root fracture resistance, Nissan et al. showed that when 2mm of ferrule was maintained, post length was not contributory (21).

Post types

There are many options for post materials and designs. Metal and zirconia posts have higher modulus of elasticity than tooth structure and withstand higher force loads. Fiber posts have a modulus of elasticity similar to dentin and evenly distribute stress along the post-dentin interface. They cause less catastrophic failure as the posts fracture or debond before the root fractures. Post rigidity results in greater stress on the root, leading to catastrophic failure. However, a rigid post withstands greater biting forces and is recommended for minimal coronal dentin. Some studies suggest that post material is more important than post design for stress distribution (22).

A post with a high modulus of elasticity, poorly adapted to canal walls and not well bonded increases the risk of vertical root fracture (22). Yet in teeth restored with fiber posts, the fracture resistance was not affected by post fit. Excessive preparation to maximize post fit is unnecessary (23).

Parallel posts apply stresses apically whereas tapered metal posts cause stress concentration cervically, resulting in a higher incidence of root fracture. Threaded metal posts are retentive but also cause more stress concentration and less fracture resistance (22). Although threaded posts are associated with catastrophic failure, shorter threaded posts may be an option for incisor teeth with short roots (24).

Other considerations

Conventional cements may disintegrate over time leading to an increase in stress concentration in the apical section of the post and decreasing the fracture resistance of the tooth (22). In extracted teeth, it was shown that posts bonded with a self-adhesive composite resin or an etch-and-rinse based system were able to withstand higher fracture loads compared to posts cemented with zinc phosphate cement (25).

Post and core retention is affected by the type of bonding system used. Dual-cure resin cements may provide better post retention than self-cure resin cements (26). Wrbas et al. found that the tensile bond strength was largely affected by the type of adhesive system used. Lowest bond strengths were obtained with self-etching, dual-cure resin cement and highest bond strengths were obtained using a self-priming, dual-cure resin cement (27). Post retention is also affected by the timing of post cementation. Vano et al. found that bond strength was significantly lower for immediate placement of fiber posts compared to placement delayed for 24 hours or 1 week because the set of the resin cement may be affected by contamination of the dentin walls with a eugenol-based sealer (28).

Conclusion

Careful consideration of root anatomy, tooth structure, post length, width and type and cementation method should be reviewed prior to post space preparation. The most successful outcomes are achieved with an adequate ferrule and minimal loss of tooth structure.

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